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## The View From Moscow

A more nationalist Duma and a more assertive foreign minister, Yevgeny Primakov, have come to power in Moscow. Both face serious challenges to achieving two of the foreign policy goals recently articulated by Primakov: defending Russia's national interests and developing ties with the United States.

In one respect, the Conventional Armed Forces in Europe (CFE) Treaty is perceived in Moscow as a challenge to Russian national interests. The agreement limits Russia's freedom to station forces in the Caucasus at a time when additional units have been dispatched to Chechnya to fight the rebels. Despite its massive reductions of conventional military equipment, Russia still exceeds the treaty's "flank" (or geographic) sub-limits as a result of these deployments to the south. NATO's proposed resolution to the problem, put forward at the last minute, would ease the flank constraints but exact a price by placing a ceiling on Russian forces elsewhere in the region.

More importantly, the CFE Treaty places overall limits on Russian armor, artillery and aircraft at a time when Washington is pressing for NATO expansion. NATO expansion would almost certainly bring Poland into the Western alliance and allow Western troops to patrol the Ukrainian and Belarusian borders. Such a dramatic change in the security calculus in Central Europe—which is controversial among the allies as well as within the United States—would make it difficult, if not impossible, for any government in Moscow to continue to abide by the CFE Treaty. Moreover, NATO expansion, coupled with the poor performance of Russian troops in Chechnya, could have the undesirable effect of increasing Moscow's reliance on nuclear weapons to compensate for the weakness of the nation's conventional forces.

Another challenge to Russia's pursuit of improved relations with the United States is congressional enthusiasm for missile defense programs. On the same day as the U.S. Senate Foreign Relations Committee approved START II, a House-Senate conference committee voted to deploy a nationwide defense against strategic ballistic missiles by 2003. The legislation, subsequently vetoed, also directed the Clinton administration not to place any constraints on theater missile defense systems. If highly capable and widely deployed, theater missile defenses could pose a serious threat to Russian strategic forces.

START II takes a healthy bite out of existing nuclear arsenals and ensures that Russian and U.S. forces remain at rough parity in an era of tight budgets and pressing conventional force requirements. But the treaty also calls for Russia and the United States to eliminate all their multiple-warhead, land-based ICBMs; these systems represent fully 50 percent of Russia's existing strategic deterrent forces and would be Russia's most obvious response to the deployment of a national missile defense by the United States.

In Russia, the nationalists argue that the reductions of START II, together with the deployment of missile defenses, will simultaneously disarm, bankrupt and strategically disadvantage the nation. The Russian military, which has hitherto been supportive of START II and its promise of parity at a lower cost, may well conclude that it would be ill-advised at this time to embark on a path to reduce or restructure Russia's nuclear deterrent forces.

In light of potential changes in the European security environment and the Russian-U.S. strategic relationship, Moscow could easily opt to abandon the CFE Treaty and delay ratification of START II until it becomes clear whether NATO expansion and ballistic missile defense will proceed. But Moscow could adopt a more sophisticated approach to confound those who support NATO expansion and ballistic missile defenses. On CFE, Moscow could settle the dispute over the flank issue as quickly as possible. Then, once CFE is in good working order, Moscow would be in a sound position to argue that the limits imposed by the CFE Treaty on Russia and the 29 other treaty parties are fundamental to European security. NATO expansion could only disrupt this arrangement and decrease the likelihood of developing a truly cooperative relationship with Russia.

Similarly, a more effective way for Moscow to defuse the drive for ballistic missile defenses is to push the new Duma for START II ratification and lock the United States into reciprocal strategic force reductions. In this event, Moscow has indicated it would condition implementation of START II on U.S. adherence to the ABM Treaty, as it did with START I, as well as on mutually agreed constraints on theater missile defense systems.

The next six months are crucial. They will test whether President Boris Yeltsin, the Duma and the new foreign minister, faced with the dual challenge of NATO expansion and ballistic missile defenses, can mesh Russia's security concerns with improved relations with the United States.

—Jack Mendelsohn

## South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement

Waldo Stumpf

On March 24, 1993, some 20 months after South Africa acceded to the nuclear Non-Proliferation Treaty (NPT) as a non-nuclear-weapon state, South African President Frederik W. de Klerk informed a joint session of Parliament, and the world at large, that in the 1970s and 1980s the government had developed a "limited nuclear deterrent capability." President de Klerk told his audience that South Africa's nuclear weapons program, whose objective was to produce seven fission devices (only six were completed), had been dismantled before Pretoria joined the NPT on July 10, 1991, and that all the country's nuclear materials and facilities were under international safeguards.

Although South Africa had signed the requisite safeguards agreement with the International Atomic Energy Agency (IAEA) on September 16, 1991 (far in advance of the 18-month deadline allowed by the NPT) and had provided the agency with a complete inventory of all nuclear materials and facilities, some speculation continued about the country's nuclear intentions and the "completeness" of its declarations. To dispel any lingering doubts about South Africa's commitment to the NPT, President de Klerk also announced that the IAEA had been granted full access to the facilities which had been used in the past for the development of South Africa's nuclear deterrent and to their records of operations. "Any doubt about the government's intentions with regard to nuclear matters must, for once and all, be removed," de Klerk said. "For this reason, the government has decided to provide full information on South Africa's past nuclear program despite the fact that the NPT does not require this." This unprecedented invitation to the IAEA to explore fully the details of the

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country's past program was given in accordance with South Africa's stated policy of full transparency after accession.

South Africa occupies a unique position in the history of the NPT as the only country that has voluntarily given up its nuclear weapons capability and then acceded to the treaty. Looking at the history of South Africa's weapons program should give some insight into the political forces that may impel a country to pursue a nuclear weapons capability as well as those forces that may facilitate a "rollback" of such a program. Furthermore, many lessons concerning the international non-proliferation regime and their relevance to the NPT may be learned from a closer examination of South Africa's weapons program, including the need to resolve regional tensions, the importance of political will and the delicate balance between international isolation and engagement.

### The Beginning: Uranium Enrichment

In 1961, South Africa's Atomic Energy Board (AEB), established by Parliament in 1948, began general nuclear research and development work at the Pelindaba Nu-

clear Research Center near Pretoria. In the early years, the AEB's activities focused on the peaceful uses of nuclear technology. In 1965, the country's first reactor—the U.S.-supplied SAFARI I research reactor—was commissioned at the Pelindaba facility.

Because South Africa was—and still is—a prominent producer of uranium, it was almost inevitable that the AEB would explore uranium enrichment technology as a means to mineral beneficiation. After achieving encouraging laboratory results with an indigenous uranium enrichment process, in 1969 the government approved the construction of a pilot plant to prove the validity of the design on an industrial scale. The design, only superficially similar to the so-called German Becker process, was much closer to the ordinary centrifuge process except that the centrifuge wall was stationary and a vortex mechanism rapidly spun the uranium hexafluoride (UF<sub>6</sub>) and hydrogen gas inside a stationary tube. The uranium isotopes were separated by centrifugal force and exited through different concentric holes in the ends of the tube.

On July 20, 1970, Prime Minister John Vorster informed Parliament of the government's intention to build the pilot enrichment plant (the Y-Plant) and stressed that the technology would be used for peaceful applications. Vorster also declared Pretoria's willingness to accept international safeguards, subject to certain conditions, including South Africa's right to use nuclear energy for peaceful purposes, that no details of the process should become public knowledge, and that there would be no interference in the normal operations of the relevant facilities.

The newly created Uranium Enrichment Corporation (established in 1970) was to oversee the program and the construction of the Y-Plant began in 1971.<sup>1</sup> The first stages at the lower end of the plant's "cascade" were commissioned in late 1974, and the entire cascade became fully operational in March 1977. Because of the Y-Plant's long

"equilibrium time" (the time needed to establish the full enrichment gradient over the length of the cascade), the first and relatively small quantity of highly enriched uranium (HEU) was withdrawn from the plant only in January 1978. During the next 19 months, the HEU that was produced was enriched to only about 80 percent uranium-235 (U-235) as the enrichment gradient had not reached full equilibrium.

In August 1979, Y-Plant operations came to an abrupt halt due to a massive catalytic in-process gas reaction between the UF<sub>6</sub> and the hydrogen carrier gas, a mixture that is thermodynamically unstable, and, when contaminated by certain impurities, can react to form uranium tetrafluoride (UF<sub>4</sub>) plus hydrofluoric acid. Although the relevant catalytic impurities were later identified and removed from the process, the Y-Plant did not resume operations until April 1980 and it was not until July 1981 that additional HEU was withdrawn. Apart from the 1979 incident, which resulted in a massive gas loss, the plant operated very smoothly during its lifetime. The Y-Plant ceased operations in February 1990, and it is now being dismantled under the supervision of the IAEA.<sup>2</sup>

### Peaceful Nuclear Explosions

During the 1960s, when the United States was actively studying the use of nuclear explosives for peaceful purposes under its Plowshares Program, South Africa began studying the feasibility of employing peaceful nuclear explosives (PNEs) for mining and construction projects. While initial efforts were confined to literature surveys, in March 1971, Minister of Mines Carel de Wet gave the AEB permission to begin preliminary investigations into the feasibility of conducting PNEs after it became certain that the country's uranium enrichment program could produce sufficient quantities in the future.

In 1974, the AEB concluded, in a report sent to Vorster, that it could successfully construct a nuclear device. That same year Vorster approved a development program for peaceful nuclear explosives that included the construction of a testing facility where underground explosions could be conducted. Although the program was directed solely toward the peaceful application of nuclear explosive technology, the government treated it as a top secret project because of the expected sensitivity surrounding the enrichment project and because the world was fast turning against the use of nuclear explosives for civil appli-

cations. This became very clear with the adverse world reaction to the 1974 detonation of a nuclear device by India, which claimed it was for peaceful purposes.

### Political and Nuclear Isolation

During the 1970s, especially the latter half of the decade, the political and military environment around South Africa deteriorated markedly. While this was due mainly to its own racially based internal policies, it was exacerbated by Portugal's withdrawal from its African colonies of Mozambique and Angola and the uncertainties about the intentions of the Soviet Union and other Warsaw Pact countries in light of their openly declared expansionist policies toward Southern Africa. The large buildup of Cuban military forces in Angola beginning in 1975, which eventually peaked at 50,000 troops, reinforced a strong perception within the government that it would remain internationally isolated should the country's territorial integrity be threatened.

Moreover, increasing international restrictions on the supply of conventional arms to South Africa, again, due primarily to its internal policies, reinforced the perception that the country had no alternative but to develop a nuclear weapon capability to counter external threats. This factor was probably the most compelling to government officials at the time.

Coupled with its continuing political isolation, South Africa was also isolated in nuclear affairs during the 1970s. Some of the nuclear-weapon states, in particular the United States, began applying unilateral restrictions on nuclear trade and exchanges of information and technology with South Africa. In 1976, despite a long-standing contract between the United States and South Africa, Washington halted further exports of fuel elements for the SAFARI research reactor, which had been under IAEA safeguards since its commissioning in 1965. Although South Africa had already paid for the fuel elements, the Carter administration did not reimburse Pretoria for the payment. (In 1981, the Reagan administration approved the return of the payment.)

One particularly important event in the late 1970s that undoubtedly shaped international attitudes was the discovery in August 1977 of South African preparations for a fully contained underground nuclear explosion at a newly constructed test site in the Kalahari Desert. The preparations at the Vastrap test site, which supposedly came to the attention of the Soviet Union and the United States through their surveillance

satellites, resulted in intense diplomatic pressure on the South African government to not conduct any nuclear test. At the instruction of President P. W. Botha, the site was abandoned that same month.

In 1978, the U.S. Congress enacted the Nuclear Non-Proliferation Act (NNPA), which precluded the transfer of U.S. nuclear technology to countries not party to the NPT. Applied retroactively to all previous agreements and contracts, the NNPA compelled the Carter administration to deny export permits to Pretoria for the shipment to France (for fuel fabrication) of the South African uranium that the U.S. Department of Energy (DOE) had been under contract to enrich. The contract between DOE and ESKOM (the South African state-owned utility company) was concluded soon after ESKOM and the French company FRAMATOME signed a reactor supply contract in 1977 for the Koeberg nuclear power station. The ESKOM-FRAMATOME agreement called for the application of full-scope IAEA safeguards at the Koeberg plant at all times.

U.S.-South African relations were further strained by an ironic twist involving the DOE-ESKOM enrichment contract. Despite the fact that the Carter administration had refused to issue ESKOM export permits for the transfer to France of the U.S.-enriched uranium, the Department of Energy nevertheless held ESKOM fully liable for payment for the enrichment work already carried out. This "Catch-22" situation was partially resolved after President Ronald Reagan assumed office in 1981, and Washington agreed that France could manufacture and deliver fuel for the Koeberg plant if ESKOM could provide the enriched uranium from a source other than the United States. The impasse was finally resolved in 1984 when the Reagan administration allowed ESKOM to sell the already-enriched uranium and the unenriched "feed" material to an NPT member-state, subject to U.S. approval. ESKOM suffered a substantial financial loss as a result of the dispute. South Africa viewed this U.S. pressure very negatively because both the SAFARI and Koeberg reactors were subject to stringent IAEA safeguards. These actions severely strained U.S.-South African nuclear relations.

On the international front, in 1977 South Africa was denied its designated seat on the IAEA Board of Governors as the "most advanced nuclear country in Africa," and this seat was given instead to Egypt. In 1979, South Africa was also barred from the IAEA General Conference in India by a resolution that also urged Pretoria to join

the NPT and to subject its nuclear activities to international safeguards. In contrast, no such action was taken against India after it tested a nuclear explosive device in 1974 and New Delhi continued to refuse to join the NPT.

These events convinced the South African government that the various sanctions were clearly politically inspired, and that Pretoria's accession to the NPT without fundamental political reform at home would not gain South Africa international acceptance. Accession to the NPT was, therefore, not seriously at the time.

### A Nuclear Deterrent Develops

Although South Africa's regional security concerns and its international isolation in the political and nuclear arenas both intensified in the mid-1970s, the country's nuclear explosive program was officially still aimed at peaceful uses until about 1977. That year, due primarily to its continuing isolation and the buildup of Cuban forces in Angola, the government officially changed the emphasis of the program to developing a nuclear deterrent capability.

In April 1978, President Botha approved a three-phase deterrent strategy. Phase 1, which was essentially already in effect, was characterized by strategic uncertainty, whereby South Africa's nuclear capability would be neither acknowledged nor denied. Should South African territory be threatened (for example, by the Warsaw Pact through surrogate Cuban forces in Angola) the government would move to Phase 2, when it would consider secret acknowledgement of the country's capability to certain international powers such as the United States. Should this partial disclosure of South Africa's capability not bring about international intervention to remove the threat to South Africa, the government would, in Phase 3, consider public acknowledgement of its nuclear capability or even a demonstration through an underground nuclear test.

No offensive tactical application of nuclear weapons was ever foreseen or intended by the government, as it was fully recognized that such an act would bring about nuclear retaliation on a massive scale. However, senior members of the South African Defense Force (SADF) became involved in the political and strategic policy-making process and with the activities at the Vastrap test site, which was located on one of the SADF's firing ranges. South Africa's deterrent strategy never advanced beyond Phase 1.

### Building the Weapons

The country's first full-scale nuclear explosive device, based on a gun-type design, had been completed by the AEB in 1977. Because the Y-Plant had not yet produced enough HEU, the device did not contain a HEU core. Nevertheless, the device was intended for a fully instrumented "cold test" (where the test device would contain a depleted uranium core). After the government abandoned the Kalahari test site in August 1977, a cold test of this first device was never carried out.

A second, smaller device built by the AEB in 1978, also intended for an instrumented test, initially lacked a HEU core because of the Y-Plant's limited production capacity. In November 1979, this device was the first to be provided with HEU from the Y-Plant, although the uranium had been enriched to only about 80 percent U-235.

In 1979, the government decided that the task of designing and building the program's additional gun-type devices would be assigned to the state-owned Armaments Corporation (ARMSCOR), with the AEB providing the HEU and its expertise in theoretical and neutron physics. A new ARMSCOR facility was constructed near Pretoria and commissioned in 1981 to begin the work, and all previously manufactured hardware was transferred to this site from other AEB facilities.

This brief history of the country's weapons program should help put to rest

the speculation as to whether South Africa was responsible for the mysterious "double flash" incident over the south Atlantic Ocean on September 22, 1979, when a U.S. Vela satellite recorded signals suggesting that a nuclear explosion had occurred. Although attention quickly focused on South Africa and Israel as the states most likely to conduct such a test, the scientific community has never been able to definitively explain the event. It is relevant to note, however, that no radioactive fallout was detected by any South African measuring station after this incident. (In the 1960s, when the nuclear-weapon states were conducting atmospheric tests in the Northern Hemisphere, fallout could be measured in South Africa within two weeks of a test.) Suggestions that South Africa could design a "clean" nuclear device without any prior testing, much less a gun-type device without a neutron initiator and using uranium that had not been enriched to weapons-grade level (that is, 90 percent or more U-235), are not credible. South Africa was neither responsible for nor involved with any other party in this incident.

The first device built at the new ARMSCOR facility was completed in December 1982, and subsequent devices followed at an orderly pace of less than one per year, essentially matching the production schedule of the Y-Plant. Although the later devices were more sophisticated in terms of their control systems, they remained bulky gun-type devices that lacked



As part of its peaceful nuclear explosives program in the mid-1970s, South Africa drilled two test shafts beneath a military testing range in the Kalahari Desert. Although the site was abandoned in August 1977 after international pressure halted South African preparations for an underground test, it remained an important component of the country's nuclear deterrent strategy that envisioned the possible need to conduct a demonstration test. After Pretoria dismantled its program, the site was sealed in June 1993 under the supervision of the International Atomic Energy Agency (above).



neutron initiators. Theoretically, these devices could have produced a yield of about 10 kilotons—about the yield of the U.S. bomb dropped on Hiroshima.

Approximately 250 people were involved in the South African weapons program at any given time, with about 1,000 individuals participating throughout the program's existence. Only a handful of the participants could be considered to have had nuclear explosives expertise. Due to the top secret nature of the program, only South African-born nationals were employed on the program; no foreign governments or expatriate personnel were ever involved in the program. The cost of the entire South African weapons program is estimated to be less than 680 million Rand (about U.S. \$500 million at historical exchange rates).

Although the political prospects facing South Africa had not improved noticeably by the mid-1980s, in September 1985 the entire weapons effort was reviewed once again and President Botha reconfirmed that the program would be limited to seven fission devices. Furthermore, only very limited work (mostly theoretical) was allowed to continue on more advanced concepts such as implosion devices and lithium-6 production. The government also reconfirmed that the devices would not be employed for offensive tactical purposes, and that the country's three-phase deterrent strategy would be maintained. (It was precisely for the latter reason that the Kalahari test site was revisited in 1987, as an underground test was still a fundamental part of Phase 3 of the strategy.)

### Factors Behind Rollback Decision

The confirmation of the program's limits in September 1985 had a markedly retarding effect on the weapons effort, and was, in retrospect, possibly the first sign of an eventual rollback of the country's nuclear deterrent. It also put an end to some earlier studies on the possible production of plutonium and tritium in a planned light-water test reactor that would be used to develop fuel for the Koeberg reactor. (By 1989, economic constraints halted subsequent plans to turn this project into a purely commercial demonstration reactor.)

Throughout the 1980s, South Africa fully recognized that its accession to the NPT without substantial domestic political reform would not result in any meaningful benefits to the country's nuclear programs. Nevertheless, during the decade Pretoria held sporadic discussions with the United

States, as well as Britain and the Soviet Union (the other two NPT depositary states) on South Africa's possible accession to the treaty.

Importantly, in the late 1980s significant regional and international developments started to ease the security situation around South Africa.

- On August 1, 1988, a cease-fire was agreed upon for Namibia's northern border, and on December 22, 1988, South Africa, Angola and Cuba signed a tripartite agreement ensuring a phased withdrawal of Cuban forces from Angola;
- On April 1, 1989, implementation began of UN Security Council Resolution 435/1978, which led to the independence of Namibia;
- The fall of the Berlin Wall in December 1989 signaled the imminent collapse of the Soviet empire, and the end of the Cold War superpower rivalry in Africa appeared inevitable.

These events coincided with the election of de Klerk as president in September 1989, who immediately set into motion fundamental domestic political reforms aimed at bringing full democracy to South Africa. With the removal of the external threat to South Africa, it became obvious that the country's nuclear deterrent was superfluous and that it could, in fact, become a liability. Furthermore, as the progress of domestic political reform became better understood abroad, accession to the NPT assumed distinct advantages for South Africa internationally and especially on the African continent.

### The Decision to Dismantle

Shortly after assuming office, President de Klerk ordered an investigation on how to completely dismantle the country's nuclear deterrent capability, with the aim of acceding to the NPT as a non-nuclear-weapon state. The first report was submitted to the president in November 1989, which he and his "small Cabinet committee" approved in principle. President de Klerk also decided that no announcement regarding South Africa's past weapons capability would be made before accession to the NPT, and that the dismantlement project would, for the time being, also be classified as top secret.

President de Klerk appointed a steering committee of senior officials from the AEC, ARMSCOR and the SADF (under the

chairmanship of the author), and the panel was given the following brief:

- Dismantle the six completed gun-type devices at ARMSCOR facilities under controlled and safe conditions;
- Melt and recast the HEU from these six devices, as well as the partially completed seventh device, and return it to the AEC for safe keeping;
- Decontaminate fully the relevant ARMSCOR facilities and return severely contaminated equipment to the AEC (such as a melting furnace);
- Convert the ARMSCOR facilities to conventional weapons work and non-weapon commercial activities;
- Destroy all hardware components of the devices as well as technical design and manufacturing information;
- Advise the government of a suitable time table for the country's accession to the NPT; signature of a comprehensive safeguards agreement with the IAEA; and submission of a full and complete inventory of nuclear material and facilities, as required by the safeguards agreement; and
- Terminate the operation of the Y-Plant at the earliest moment.

Although the Y-Plant closed down on February 1, 1990, actual written confirmation of these instructions was received from President de Klerk on February 26, 1990. This date, therefore, should stand as the official date of implementation of the termination of South Africa's weapons program.

### Dismantlement and NPT Accession

The dismantlement of the high-enrichment end of the Y-Plant's cascade started without delay. Extensive operational procedures for the safe and secure dismantlement of the nuclear devices were drawn up in July 1990, before the dismantlement of the first device began. President de Klerk appointed an independent auditor, Wynand Mouton, a retired nuclear physicist and university president, to independently audit the entire denuclearization process to ensure that no diversion of nuclear materials occurred.

The dismantlement process proceeded without incident and was essentially complete by the end of June 1991, with the last HEU returned to the AEC on September 5-6. Following Pretoria's accession to the NPT on July 10, 1991, South Africa submitted its initial inventory of nuclear materials and facilities to the IAEA on October 30,

1991, and the agency's first verification team arrived on-site that November.

The question has often been asked whether public acknowledgement by South Africa of its nuclear weapons program should not have been made at the time of its accession to the NPT. Although a valid question, it is important to remember that such a disclosure is not required by the NPT, which is concerned with a country's nuclear activities from the date of its accession. Moreover, while the IAEA was responsible for verifying the "completeness" of South Africa's declaration of materials and facilities, the agency's mandate did not include past projects or programs that had been fully terminated before accession. South Africa was, therefore, under no obligation to reveal the existence of its past weapons program.

Nevertheless, South Africa had considered public acknowledgement of the weapons program at the time of its accession to the NPT, but had rejected the move for two reasons. First, the state of the country's internal political transformation was not considered conducive to such an announcement at the time. Second, the confrontational verification process then unfolding between Iraq and the IAEA, which was then receiving intense press attention, convinced South Africa that it could easily have been branded as a second nuclear outlaw nation despite the fact that Pretoria had not violated the NPT as Iraq had done.

### The IAEA Verification Process

Verification by the IAEA of the completeness of Pretoria's declaration of nuclear materials and facilities was no easy task, and the agency's experience with South Africa offers valuable lessons for the future. The NPT is designed to monitor a country's nuclear activities only *after* it has acceded to the treaty; it is not really concerned with the state's *past* actions. But implementation of the NPT in a country with substantial nuclear fuel cycle activity will, without doubt, force the agency to delve into the country's past activities to ensure that no undeclared materials and facilities are carried over after accession.

The IAEA's normal safeguards agreements cannot handle such a situation very easily and special measures must be designed. While these measures could, of course, include the IAEA's recourse to special inspections, experience in both Iraq and North Korea has shown that this procedure often leads to confrontation. A policy of

openness and transparency by the party acceding to the NPT is far more conducive to the aims and the spirit of the treaty. South Africa accepted this fact even before its accession. It adopted a policy of full transparency and issued a standing invitation to the IAEA for inspections "anywhere, any time, any place—within reason."

Initially, the IAEA requested access to a wide range of facilities, including many dedicated to conventional arms production. Although access was granted in every case during the early phase of inspections and later on a case-by-case basis, the IAEA and South Africa have since agreed that many of the facilities can be removed from the agency's list of sites. Should the IAEA ever feel it necessary to request access to one of the sites in the future, access will be granted as long as the request is reasonable.

Despite this transparency, IAEA verification of the completeness of South Africa's inventory was no easy task, as the agency had to analyze production and material records for a period covering 20 years or more. The IAEA even tested the authenticity of the operating records through tests of the paper and ink. The verification of the HEU output of the pilot enrichment plant—through a material balance calculation based on the plant's operations records and on the natural uranium inputs, depleted uranium outputs and in-process gas losses—posed a particularly difficult problem.

After 21 months of correlating operation records and the declared inputs and outputs, in September 1993 the IAEA General Conference accepted the completeness of South Africa's inventory of materials and facilities. Likewise, the conference also accepted Pretoria's declarations on the dismantlement and destruction of the hardware from the nuclear devices; on the reassignment of "dual-use" equipment and facilities to non-nuclear or peaceful nuclear work; and on the destruction, under IAEA supervision, of the two test shafts.

These positive findings essentially brought to an end the agency's special investigations, and the IAEA and South Africa have since maintained an ongoing, normal application of safeguards on the country's nuclear activities.

Recent sensational claims by Peter Hounam and Steve McQuillan, authors of the recently published book *The Mini-Nuke Conspiracy: Mandela's Nuclear Nightmare*, that South Africa had built "24 large atomic and nuclear bombs and up to 1,000 battlefield nuclear shells, that could be fired from long-range howitzers" should be dismissed. South Africa produced only

enough HEU for seven nuclear devices. For the arsenal they have suggested, 20 to 25 tons of HEU would have been needed—an inconceivably large amount of material for the IAEA to miss during its investigation. Alternatively, the 1,000 tactical weapons might have been made using plutonium and implosion technology, requiring eight to 10 tons of plutonium as well as neutron initiators, but the IAEA found no trace of plutonium in South Africa despite extensive environmental testing. Although the authors have been invited to submit their findings to the IAEA for analysis, they have so far refused.

### A Commitment to Non-Proliferation

Since the end of the 1980s, South Africa has undergone a fundamental transformation, attaining full acceptance as a respected member of the international community. This transformation, based on a total reorientation of the country's political, social and economic order, resulted in the election of Nelson Mandela as president on April 27, 1994, in the country's first-ever, fully democratic elections. Since then, the South African government has, on numerous occasions, committed itself to a policy of transparency with regard to the non-proliferation of weapons of mass destruction. This commitment was reflected in the Cabinet's August 31, 1994 decision to implement a policy on the non-proliferation of weapons of mass destruction. It was also publicly expressed by President Mandela during 1994 at the OAU heads of state summit and at the opening of the 49th session of the UN General Assembly. More recently, Foreign Minister Alfred Nzo reiterated this commitment during the April-May 1995 NPT review and extension conference in New York.

One of the cornerstones of South Africa's transformation is the country's firm resolve to make a meaningful contribution in Africa, and with the easing of Cold War tensions, to a more peaceful global order. The dismantlement of South Africa's nuclear weapons program and the country's accession to the NPT should be seen in the light of this fundamental shift. South Africa's constructive role in promoting international non-proliferation was much in evidence at the NPT extension conference where Pretoria played a meaningful role as "bridge-builder."

With its well-developed industrial strength and its significant nuclear know-how, South Africa also has a vital role to play in furthering equitable objectives of

the Zangger Committee and the Nuclear Suppliers Group. South Africa is a member of both export control bodies, and the country has enacted the necessary legislation to support its nuclear non-proliferation commitments.

On August 16, 1993, an "Act on the Control of Non-proliferation of Weapons of Mass Destruction" was promulgated after having been passed earlier by the South African Parliament. This act makes it a criminal offense for any South African citizen to develop, or assist in the development of, chemical, biological and nuclear weapons as well as ballistic missiles capable of delivering such weapons. It also establishes effective national control over the import and export of dual-use equipment and related materials and on their use.

In 1993, Parliament passed a revised Nuclear Energy Act that embodies the obligations brought about by South Africa's accession to the NPT and the country's safeguards agreement with the IAEA. In particular, this legislation prohibits the export of nuclear materials or related equipment or facilities to nuclear-weapon states unless it is used only for peaceful purposes, and to non-nuclear-weapon states unless they have signed a comprehensive safeguards agreement with the IAEA.

Finally, Africa's long-sought goal of declaring the continent a nuclear-weapon-free zone is now a reality. Negotiations on finalizing the draft text of this treaty were concluded at Pelindaba, the AEC's headquarters near Pretoria, on June 2, 1995. Approval of the draft text by the OAU and the United Nations means that the treaty could be open for signature as early as February 1996.

South Africa's nuclear rollback, its open admission of the details of its past weapons program and its involvement in promoting the peaceful application of nuclear technology in Africa have led to many calls from the drafters of the Africa treaty to name the accord "The Pelindaba Treaty." This suggestion has attracted further support because of the indigenous meaning of the word "Pelindaba," which, translated, means "We have concluded discussions."

#### Lessons for the Future

South Africa's development and eventual dismantlement of a nuclear deterrent capability offers several lessons for international non-proliferation efforts. These lessons may be particularly useful as the world slowly progresses toward universal adherence to the NPT and the ultimate goal

of eliminating nuclear weapons from national arsenals. Among the most important lessons are:

- Although the technology needed to enrich uranium and build unsophisticated nuclear weapons is of a very high level, it is still within the bounds of a reasonably advanced industrialized country and is, therefore, not in itself an insurmountable barrier. This is particularly true when a state's technical goals are relatively modest, as was the case with South Africa's decision to construct gun-type devices without neutron initiators.
- While Iraq's vast nuclear weapons program and the huge financial and human resources it required may leave the impression that the costs of such a program are a self-limiting constraint, the South African experience proved otherwise. The costs incurred by South Africa appear to be a fraction of the reported costs of the Iraqi program.
- Although international political isolation may be an effective instrument to contain individual cases of nuclear proliferation, a point may be reached where political leverage is lost and the isolation becomes counter-productive, pushing the would-be proliferator toward full proliferation. In the case of South Africa, this point was probably reached in the mid-1970s after the United States cut off the contractual supply of fuel for the SAFARI and Koeberg reactors, together with the punitive financial measures applied by the U.S. administration at the time. Whatever leverage the United States had then over the South African nuclear program was lost.
- If proliferation has occurred because of a real or perceived political or military threat, a rollback may be possible only after the removal or neutralization of the threat, whether it was real or perceived. This means that pressure by a superpower on a would-be proliferator can be helpful but only up to a point. In the final instance, regional tensions must be resolved before the impetus for proliferation can be addressed. This was true for South Africa and it is probably the case in the Middle East, South Asia and the Korean Peninsula.
- Nuclear rollback (to permanent non-nuclear-weapon-state status under the NPT) will probably not be achieved on the basis of technical, military or strategic decisions. Such a reversal re-

quires a fundamental political decision by a country's political leadership.

- For the so-called threshold nuclear-weapon states (India, Israel and Pakistan), the rollback option is not an easy path to follow because the NPT and its associated instruments were not designed to deal with the process of denuclearization. The international community should be cautious in the application of pressure on a threshold state that has taken the fundamental decision to roll back its weapons program. South Africa experienced much unnecessary international pressure during the "completeness investigation" by the IAEA which could have, under different circumstances, derailed the process.
- For a threshold state that has made the political decision to roll back its weapons program and join the NPT, the process can be eased considerably by a sustained policy of full openness and transparency with the IAEA. Ultimately, this is also a decision that must be made by political leaders.

South Africa's decision to voluntarily dismantle its nuclear deterrent capability and embrace fully its responsibilities as a non-nuclear-weapon state will guarantee Pretoria an unprecedented place of honor in the evolution of the international non-proliferation regime. While public debate over the merits or demerits of Pretoria's decision will probably carry on for a long time, this chapter of the country's history should now be closed, only to be re-opened so that all may learn from the past.

South Africa looks forward to a future of peaceful coexistence and prosperity in a part of the world that hopefully is now free of the internal threat of nuclear weapons and, with the genesis of a nuclear-weapon-free zone in Africa, free of the imprint of the arsenals of the nuclear-weapon states on African soil.

ACT

#### NOTES

1. In 1982, the Uranium Enrichment Corporation was incorporated, along with the Atomic Energy Board, into the present Atomic Energy Corporation (AEC).

2. The high-enrichment portion of the Y-Plant's cascade has been fully decommissioned, and the construction of a prototype demonstration module for the AEC's Molecular Laser Isotope Separation (MILS) project is being carried out in the building. This project, which is under full-scope IAEA safeguards, is designed for commercial, low enrichment of UF<sub>6</sub> in a single step.

## The Pelindaba Treaty: Africa Joins the Nuclear-Free World

David Fischer

If "Pelindaba" has meant anything at all to students of arms control, it has been in connection to the nuclear research center near Pretoria where, during the 1970s, South Africa conducted much of its secret research and development work on the country's now-dismantled nuclear weapon capability. (See p. 3.) Today, however, Pelindaba has taken on a distinctly peaceful connotation: The "Pelindaba Treaty" is the informal name of the soon-to-be-signed pact that will establish Africa as the world's fourth nuclear-weapon-free zone (NWFZ). When the treaty enters into force—perhaps as early as next year—it will, along with the 1959 Antarctic Treaty, the 1967 Tlatelolco Treaty (for Latin American and Caribbean states) and the 1986 Rarotonga Treaty (covering the South Pacific), transform most of the Southern Hemisphere into a zone free of nuclear weapons.

The negotiation of the Pelindaba Treaty has been a long and arduous task. It has taken more than 35 years to complete the treaty since African states first voiced interest in an NWFZ in 1960. In February of that year France conducted its first nuclear test—above ground—in Algeria, during the U.S.-British-Soviet testing moratorium that began in 1958. (France conducted three additional atmospheric tests in Algeria before it moved its testing program there underground in 1961.)

In swift reaction, a group of eight African countries proposed a resolution at the UN General Assembly calling on all states to respect Africa as a nuclear-weapon-free zone and to refrain from testing, storing or transporting nuclear weapons in Africa. While the 1960 resolution was never put to a vote, the General Assembly approved a

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***"[T]he Pelindaba Treaty will encourage the creation of other nuclear-weapon-free zones, particularly in Southeast Asia and the Middle East, and set new patterns and precedents for such regional endeavors."***

similar resolution the following year. In 1964, African countries intensified their efforts by adopting a "Declaration on the Denuclearization of Africa" at the first summit conference of the Organization of African Unity (OAU)—a move that the General Assembly endorsed in 1965 and every year thereafter until 1990.

When France stopped testing in Algeria in 1966 after 13 underground tests, the immediate incentive to ban nuclear weapons from the African continent receded. But in 1970, the government of South Africa announced that it had developed a new technology for enriching uranium, and suspicions soon mounted that Pretoria was intent on acquiring nuclear weapons. While the uncertainty surrounding South Africa's nuclear intentions was heightened mostly by a series of deliberately ambiguous policy statements emanating from Pretoria, much more ominous signals were on the horizon. In August 1977, Soviet and U.S. satellites detected what appeared to be preparations by South Africa for an underground nuclear test in the Kalahari Desert. Strong diplomatic demarches by the United

States, Britain and France compelled Pretoria not to test any nuclear explosive device at the site. Suspicions over South Africa's weapons program were further heightened in September 1979, however, when a U.S. VELA satellite registered what could have been a flash from a nuclear test over the South Atlantic, prompting speculation that South Africa had tested an explosive device.<sup>1</sup>

As long as South Africa was believed to have a nuclear arsenal, it was impossible for other African countries to conclude a nuclear-weapon-free-zone treaty. Their first objective was to rid the continent of existing weapons; only then could meaningful negotiations begin on a treaty. But throughout the late 1970s and early 1980s, South Africa remained politically and economically isolated and seemingly intent on building up its suspected arsenal.

However, with the election of Frederik W. de Klerk as president of South Africa in September 1989 and the promise of political reform, the 1990s offered African countries a new window of opportunity and they acted on it immediately. In December 1990, the General Assembly approved a new Africa-sponsored resolution that, in part, called on the UN secretary-general to assist the OAU in convening "a meeting of experts" in 1991 to discuss the drafting and implementation of a denuclearization accord. Two "groups of experts," one designated by the United Nations in cooperation with the OAU and the other an OAU inter-governmental panel, began their joint efforts. The groups were joined by experts from the International Atomic Energy Agency (IAEA) and the treaties of Rarotonga and Tlatelolco.

At their first meeting in May 1991 in Addis Ababa, Ethiopia, the participants recommended that, in view of the changing situation in Southern Africa and the world, the time was right to begin working on a treaty for the denuclearization of Africa. They also emphasized that South Africa's